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(54) RECIPROCATING WRENCH FOR QUICK COMBINING FASTENER

(57) A reciprocating wrench (100) for quick combining fastener (50) includes a main body (10), a claw (20), and an elastic positioning device (30) therebetween. The main body (10) includes a concavely-shaped first jaw opening (11), which has a pivot end (12) at an end thereof. The claw (20) includes a concavely-shaped second jaw opening (21), which has a pivotal combination portion (22) at an end thereof. The pivotal combination portion (22) is pivotally connected with the pivot end (12), such that the claw (20) and the main body (10) pivotally move with respect to each other. The elastic positioning device (30) allows the claw (20) to optionally rotate toward a closing direction or remain in the opening status. Therefore, the claw (20) is able to remain in the opening status for combining the fastener (50).

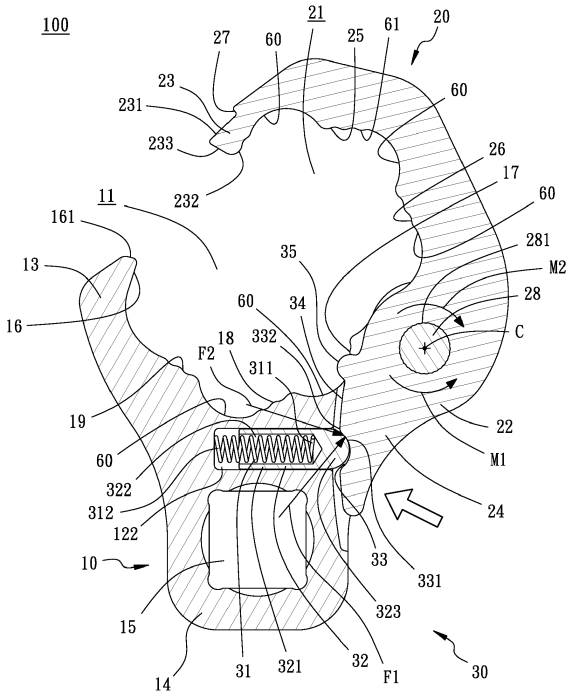

FIG. 4

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention:

[0001] The present invention relates to reciprocating wrenches, and more particularly, to a reciprocating wrench for quick combining fastener.

2. Description of the Related Art:

[0002] As shown by the wrench of US patent 6,978,701, the head portion thereof has a ring component, such that the ring component is mounted around a hexagonal nut. However, when the hexagonal nut is to be fastened, after driving the nut to rotate in clockwise by 60 degrees through the wrench, the user needs to detach the wrench from the hexagonal nut along the axial direction of the nut, rotates the wrench in counterclockwise by 60 degrees, re-mounts the ring component around the nut, and repeats the aforementioned wrenching operations. Such operations are time costing, and such type of wrench is not categorized under a quick operative wrench.

[0003] Also, as shown by WO2018/167520A1 "LINE WRENCH HEADS AND LINE WRENCHES", a line wrench includes a wrench head, a fixed head portion, and a pivoting head portion, wherein the pivoting head portion pivotally moves to open with respect to the fixed head portion. Further, a resilient portion is disposed between the wrench head and the pivoting head portion, such that the pivoting head portion is maintained at a closing position with respect to the fixed head portion. Therefore, the line wrench is able to be efficiently engaged with a hexagonal fastener on an oil-pipe through the pivoting operation of the pivoting head portion with respect to the fixed head portion, thereby screwing the hexagonal fastener. However, such oil-pipe wrench applies the function of the resilient portion, so that the fixed head portion and the pivoting head portion are normally closed with respect to each other. Therefore, when the wrench is applied, the user needs to press the pivoting head portion by fingers, and then release the fingers for the pivoting head portion to be recovered to the original position when the oil-pipe enters the operation range of the pivoting head portion. During such operation processes, based on the fact that the fingers of the user being closed to the wrench head, the operation is easily hindered in a relatively narrow working space, and the wrench is kept from entering the peripheral range of the oil-pipe for combining the fastener for operation. Further, in a high temperature oil-pipe operating environment, the user may suffer a hand burnt accident when trying to press the pivoting head portion.

[0004] In addition, US9884409 discloses an oil-pipe wrench, wherein the pivotal member thereof has a distal end inserted in the second recess during the fastening process of the hexagonal object. For facilitating the function, two separate pivots (first and second locking members) are required, such that the pivotal members have two different pivot centers, so as to remove the distal end of the pivotal member from the second recess. However, such design increases the structural complexity and the cost thereof, which is still not optimal. Similarly, such wrench is easily hindered in the operation in a relatively narrow working space, so as to be kept from entering the peripheral range of the oil-pipe for combining the fastener for operation. Also, in a high temperature oil-pipe operating environment, the user may suffer a hand burnt accident when trying to press the pivoting head portion.

[0005] Based on the aforementioned reasons, the applicant develops a reciprocating wrench for quick combining the fastener for providing a convenience of safe usage and operation of the wrench.

SUMMARY OF THE INVENTION

[0006] For improving the issues above, a reciprocating wrench for quick combining fastener is disclosed. With the claw which is able to be kept opening, the user is able to insert the wrench into the peripheral range of the oil-pipe for combining the fastener for carrying out the wrenching operation without the need to press the claw, so as to overcome the space limitation and achieve the convenience of operation.

[0007] For achieving the aforementioned objectives, a reciprocating wrench for quick combining fastener in accordance with an embodiment of the present invention is provided, comprising a main body, a claw, and an elastic positioning device. The main body has a concavely-shaped first jaw opening, which has a pivot end on one side thereof. The claw has a concavely-shaped second jaw opening, which has a pivotal combination portion on one side thereof. The pivotal combination portion of the claw is pivotally connected with the pivot end of the main body along a pivot center, such that the claw is allowed to pivotally rotate with the pivot center as the rotation center in order to rotate toward a closing direction or an opening direction. The elastic positioning device is disposed between the main body and the claw, so that the claw is allowed to optionally rotate toward the closing direction or the opening direction.

[0008] With such configuration, the claw of the present invention does not need to be continuously pressed for maintaining the opening status, such that the wrench is easily inserted into the peripheral range of the fastener for combining the fastener to carry out the wrenching operation, without being limited by the narrow operation space. Also, the requirement and inconvenience of continuously pressing the claw are saved, and the operation safety of the user is assured.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is a perspective view of the reciprocating wrench for quick combining fastener in accordance with a first embodiment of the present invention.

Fig. 2 is an exploded view of the reciprocating wrench for quick combining fastener in accordance with the first embodiment of the present invention.

Fig. 3 is a sectional view of the reciprocating wrench for quick combining fastener, illustrating the wrench at the normal position with the claw facing the closing direction.

Fig. 4 is a transverse sectional view of the reciprocating wrench for quick combining fastener in accordance with the first embodiment of the present invention, illustrating the claw at the first position and opening with respect to the main body before combining the fastener.

Fig. 5 is a schematic view of the reciprocating wrench for quick combining fastener in accordance with the first embodiment of the present invention, illustrating the wrench in the opening status, with the hand of the user griping the hand tool to approach the fastener of the oil-pipe.

Fig. 6 is a schematic view of the reciprocating wrench for quick combining fastener in accordance with the first embodiment of the present invention, illustrating the wrench combining the fastener in the two jaw openings.

Fig. 7 is a schematic view of the reciprocating wrench for quick combining fastener, illustrating release portion resisting the third obverse force bearing face, with the claw pivoting to away from the first position.

Fig. 8 is a transverse sectional view of the reciprocating wrench for quick combining fastener, illustrating the claw at the second position in the closing status with respect to the main body and completely combining the fastener.

Fig. 9 is a schematic view of the reciprocating wrench for quick combining fastener, illustrating the wrench completely combining the fastener on the oil-pipe.

Fig. 10 is a schematic view of the reciprocating wrench for quick combining fastener, illustrating the fastener being driven to rotate in a clockwise direction.

Fig. 11 is an enlarged view of the reciprocating wrench for quick combining fastener, illustrating the second tip elastically expanding to resist against the first tip after the fastening process.

Fig. 12 is a transverse sectional view of the reciprocating wrench for quick combining fastener in accordance with a second embodiment of the present invention, illustrating the positioning member of the elastic positioning device resisting against the position limiting area, with the claw facing the closing direction.

Fig. 13 is a transverse sectional view of the reciprocating wrench for quick combining fastener in accordance with a third embodiment of the present invention, illustrating the positioning member which is a magnet disposed between the claw and the main body, with the claw at the first position.

Fig. 14 is a schematic view of the reciprocating wrench for quick combining fastener in accordance with a fourth embodiment of the present invention, illustrating the wrench being a double-headed wrench, with the operation portion being a long handle.

DETAILED DESCRIPTION OF THE INVENTION

[0010] The aforementioned and further advantages and features of the present invention will be understood by reference to the description of the preferred embodiment in conjunction with the accompanying drawings where the components are illustrated based on a proportion for explanation but not subject to the actual component proportion. Embodiments of the present invention are illustrated in detail along with the drawings. However, the technical features included by the present invention are not limited to certain embodiments hereby provided. Scope of the present invention shall be referred to the claims, which include all the possible replacements, modifications, and equivalent features.

[0011] Referring to **Fig. 1** to **Fig. 11,** a reciprocating wrench **100** for quick combining fastener **50** in accordance with a first embodiment of the present invention is provided, comprising a main body **10,** a claw **20,** and an elastic positioning device **30.**

[0012] The main body **10** has a concavely-shaped first jaw opening **11.** The first jaw opening **11** has a pivot end **12** on one side and a first tip **13** on another side in opposite to the pivot end **12.**

[0013] The claw **20** has a concavely-shaped second jaw opening **21.** The second jaw opening **21** has a pivotal combination portion **22** on one side and a second tip **23** on another side in opposite to the pivotal combination portion **22.** The pivotal combination portion **22** of the claw **20** is pivotally connected with the pivot end **12** of the main body **10** along a pivot center C, such that the claw **20** is allowed to pivotally rotate with the pivot center **C** as the rotation center **X** in order to rotate toward a closing direction or an opening direction. The claw **20** and the main body **10** are allowed to pivotally move between a first position and a second position with respect to each other. As shown by **Fig. 4,** when the claw **20** is at the first position, the claw **20** remains opening with respect to the main body **10.**

[0014] The elastic positioning device **30** is disposed between the main body **10** and the claw **20,** and the claw **20** is able to rotate toward the closing direction or optionally remained open. In the opening status, the wrench **100** is applied for combining the fastener **50.** As shown by **Fig.** 5 to **Fig. 11,** the wrench **100** is allowed to be engaged with the fastener **50,** such as the one being disposed on an oil-pipe, so that the fastener **50** is screwed to be fastened or loosened.

[0015] The fastener **50** is a hexagonal thread bolt,

wherein a hexagonally-shaped head portion thereof has a first force bearing face **51A** to a sixth force bearing face **56A** sequentially disposed in a counterclockwise direction from the 9 o'clock direction. Similarly, the fastener **50** has a first obverse force bearing face **51B** to a sixth obverse force bearing face **56B** sequentially disposed. The wrench **100** is engaged with the fastener **50** and wrenches the fastener **50** along a rotation center **X,** wherein the rotation center **X** is the axle of the fastener **50.**

[0016] When the wrench **100** is engaged with the fastener **50** for carrying out the fastening operation, the fastener **50** is positioned in the first jaw opening **11** and the second jaw opening **21.**

[0017] The first tip **13** has a block face **16.** The first jaw opening **11** of the main body **10** further has a first forcing face **17,** a second forcing face **18,** and a third forcing face **19** sequentially disposed in a clockwise direction on one side of the block face **16,** as shown by **Fig. 3** and **Fig. 8.** When the wrench **100** is engaged with the fastener **50,** the block face **16** faces the claw **20;** the first forcing face **17,** the second forcing face **18,** and the third forcing face **19** face the fourth force bearing face **54A,** the third force bearing face **53A,** and the second force bearing face **52A** of the fastener **50,** respectively. Therefore, when the wrench **100** is engaged with the fastener **50,** the main body **10** correspondingly surrounds the three force bearing faces of the fastener **50.**

[0018] The pivotal combination portion **22** of the claw **20** is pivotally connected with the pivot end **12** of the main body **10** through a single trunnion **28** along the pivot center **C,** such that the claw **20** and the main body **10** are able to pivotally move with respect to each other. The pivot end **12** of the main body **10** includes two pivot ears spaced with each other, and each pivot ear comprises a first pivot hole **121,** respectively. The claw **20** comprises a second pivot hole **221.** The trunnion **28** passes through the first pivot holes **121** and the second pivot hole **221** along the pivot center **C,** such that the claw **20** is pivotally connected with the main body **10.** The trunnion **28** has a tooth portion **281** formed on the middle section thereof, wherein the outer diameter of the tooth portion **281** is larger than the inner diameter of the second pivot hole **221,** such that the second pivot hole **221** of the pivotal combination portion **22** is fittingly engaged with the tooth portion **281.** Therefore, when the trunnion **28** is disposed between the main body **10** and the claw **20,** the trunnion **28** is fixed in the second pivot hole **221.**

[0019] The main body **10** has an operation portion **14** formed on a position away from the first jaw opening **11.** In the first embodiment, the operation portion **14** of the main body **10** comprises a combination bore **15,** and the central line of the combination bore **15** passes through the main body **10** and is arranged in parallel to the rotation center **X.** The combination bore **15** of the main body **10** is combined with the driving end of a hand tool **1,** so that the user wrenches the hand tool **1** to drive the fastener **50** through the main body **10.** Therein, the hand tool **1** is a handle.

[0020] In addition, a press member **24** extends to be formed on the pivotal combination portion **22** of the claw **20,** such that the user is able to press the press member **24** for opening the claw **20** with respect to the main body **10.**

[0021] The second tip **23** has a shape gradually widening toward the distal end of the claw **20.** The second tip **23** includes an outer retaining face **231** and an opposite inner retaining face **232.** The longest distance between the outer retaining face **231** and the pivot center **C** is a first radius **R1,** and the shortest distance between the inner retaining face **232** and the pivot center **C** is a second radius **R2,** wherein the first radius **R1** is larger than the second radius **R2.** Notably, when the claw **20** pivotally sways, the claw **20** pivotally moves with respect to the main body **10** along the first radius **R1** and the second radius **R2.** When the claw **20** is at the second position and the wrench **100** is not engaged with the fastener **50,** the first radius **R1** is smaller than the shortest distance between the first tip **13** and the pivot center **C.** When the wrench **100** is engaged with the fastener **50** for carrying out the fastening operation, the wrench **100** easily drives the fastener **50** to rotate.

[0022] The wrench **100** of the present invention comprises a first imaginary line **L1** and a second imaginary line **L2.** As shown by **Fig. 8,** when the wrench **100** is engaged with the fastener **50,** the first imaginary line **L1** passes through the pivot center **C,** the rotation center **X** of the fastener **50,** the second tip **23,** and the first tip **13.** The second imaginary line **L2** passes through the first imaginary line **L1** and the rotation center **X.** An outer side of the block face **16** is connected with a first connection face **161,** with a second connection face **233** formed between and connecting the outer retaining face **231** and the inner retaining face **232.**

[0023] When the wrench **100** is engaged with the fastener **50,** the block face **16** faces the outer retaining face **231** of the claw **20,** and the first forcing face **17,** the second forcing face **18,** and the third forcing face **19** face the fourth force bearing face **54A,** the third force bearing face **53A,** and the second force bearing face **52A** of the fastener **50,** respectively. The inner retaining face **232** faces the first force bearing face **51A** of the fastener **50.** Further, the claw **20** comprises a fourth forcing face **25** and a fifth forcing face **26,** which face the sixth force bearing face **56A** and a fifth force bearing face **55A** of the fastener **50,** respectively, such that the claw **20** surrounds the other three force bearing faces of the fastener **50.** Meanwhile, a first inclination angle θ**1** is included by the block face **16** and the first force bearing face **51A,** and a second inclination angle θ**2** is included by the outer retaining face **231** and the first force bearing face **51A.** The second inclination angle θ**2** is smaller than the first inclination angle θ**1.**

[0024] In addition, a plurality of concaves **60** are disposed on the inner edge of the first jaw opening **11** and the second jaw opening **21** for facing a second obverse force bearing face **52B,** a third obverse force bearing

face **53B,** a fourth obverse force bearing face **54B,** a fifth obverse force bearing face **55B,** and a sixth obverse force bearing face **56B** of the fastener **50,** respectively, such that the concaves **60** are able to face the five corners of the fastener **50** in the engagement of the wrench **100** and the fastener **50.** Therefore, during the wrenching process, the corners of the fastener **50** are prevented from overly worn. The fourth forcing face **25,** fifth forcing face **26,** and the inner retaining face **232** comprise a plurality of skid proof grooves **61,** respectively, for preventing the skidding against the fastener **50.** Further, in the first embodiment of the present invention, each of the first forcing face **17,** the second forcing face **18,** and the third forcing face **19** has a plurality of skid proof grooves **61,** respectively, for achieving a skid proof function.

[0025] The elastic positioning device **30** includes an elastic member **31,** a positioning member **32,** and a positioning area **33** which is formed on the claw **20.** The elastic member **31** is disposed on the main body **10** and provides the elastic recovering force for the claw **20** to rotate toward the closing direction. The positioning member **32** is disposed between the main body **10** and the claw **20,** and optionally resists against the positioning area **33,** such that the claw **20** optionally remains in the opening status. The positioning area **33** includes a positioning face **331** and a dividing side **332** disposed on one side of the positioning face **331.** The distance from the positioning face **331** to the pivot center **C** is smaller than the distance from the dividing side **332** to the pivot center **C.** A slide area **34** is formed on one side of the positioning area **33,** so as to be pushed by the elastic member **31** and slide with respect to the positioning member **32.** At the first position, the positioning member **32** of the elastic positioning device **30** resists against the positioning area **33.** The main body **10** has an installation notch **122** formed on the pivot end **12** and facing the claw **20.** The elastic member **31** is disposed in the installation notch **122** and pushes the positioning member **32.** The positioning member **32** is slidably disposed in the installation notch **122** and pushes the claw **20,** so that the claw **20** normally moves toward the first tip **13.** The elastic member **31** is a compression spring, and the positioning member **32** is a hollow pin formed of metal material. In the first embodiment, the elastic member **31** and the positioning member **32** are arranged in a coaxial alignment. The positioning member **32** has a body portion **321,** and the body portion **321** is slidably disposed in the installation notch **122** and comprises an inner bore **322** whose sectional face is formed in a circular shape. Also, the positioning member **32** has a hemisphere shaped resisting end **323** formed on one end in opposite to the inner bore **322** and connected with the body portion **321.** The positioning area **33** is an arc shaped groove formed on the claw **20** and faces one side of the main body **10.** Also, elastic member **31** comprises a pushing end **311** and an inner end **312.** The pushing end **311** pushes the inner bore **322** of the positioning member **32,** and the inner end **312** contacts the installation notch **122.**

[0026] The elastic positioning device **30** is disposed between the main body **10** and the claw **20,** such that the claw **20** is able to rotate toward the closing direction for the wrench **100** to combine the fastener **50.** When the press member **24** is pressed by the fingers of the user or other external force, the claw **20** is allowed to rotate toward the opening direction until the positioning member **32** of the elastic positioning device **30** resisting against the positioning area **33** for generating a first force **F1** and a second force **F2** imposed upon the positioning face **331** of the positioning area **33.** A torque **M1** generated by the first force **F1** upon the pivot center **C** offsets a obverse torque **M2** generated by the second force **F2** upon the pivot center **C** (i.e. the torque **M1** being equal to the obverse torque **M2**), such that the elastic positioning device **30** resists against the positioning face **331** of the positioning area **33** to reach a force balancing status. Therefore, the claw **20** is at the first position and remains open with respect to the main body **10,** as shown by **Fig. 4.** In other words, the force imposed by the positioning member **32** of the elastic positioning device **30** upon the positioning area **33** is completely transmitted to the pivot center **C** through the positioning face **331,** so that the claw **20** remains in the opening status. At the same time, the wrench **100** is able to easily and conveniently approach the peripheral area of the oil-pipe, as shown by **Fig. 5.**

[0027] When the user needs to combine the fastener **50** with the wrench **100,** as shown by **Fig. 6,** which means that the claw **20** leaves the opening status, the user imposes a force on the wrench **100,** such as by wavering the wrench **100** or contacting the oil-pipe with the main body **10** of the wrench **100.** The movement of the main body **10** causes the mass of the claw **20** to generate an inertia of rotation toward the closing direction, such that the inertia of the claw **20** surpasses the static friction between the positioning face **331** and the positioning member **32** and also the resistance of the dividing side **332,** whereby the positioning member **32** crosses the dividing side **332** and slides to reach the slide area **34.** As a result, the claw **20** pivots from the opening status in **Fig. 6** to the closing status at the second position in **Fig. 8.** Briefly speaking, the user applies the inertia of the claw **20** to remove the positioning effect of the elastic positioning device **30,** without the need of using the hands to approach the claw **20** near the oil-pipe, assuring the safety and convenience of usage.

[0028] In addition to the application of inertia for removing the opening status of the claw **20,** in the first embodiment, another technique is applied to reach the identical technical effect. The elastic positioning device **30** further includes a release portion **35** disposed on the claw **20** away from the positioning are **33.** At the first position, the release portion **35** protrudes from the inner side of the first jaw opening **11** with respect to the main body **10,** as shown by **Fig. 6.** Therefore, in the opening status of the wrench **100,** the user applies the release portion **35** to resist against the fastener **50** or the oil-pipe, so that

the wrench **100** recovers to the second position from the first position. Referring to **Fig. 7,** when the claw **20** is at the first position, the user applies the release portion **35** to resist against one lateral side of the fastener **50,** such that the counterforce is imposed upon the claw **20.** As a result, the claw **20** pivots about the pivot center **C** to rotate toward the closing direction, so that the positioning member **32** of the elastic positioning device **30** crosses the dividing side **332** from the positioning area **33** and slides to reach the slide area **34.** Therefore, the claw **20** pivots from the first position to the second position, achieving the closing status with respect to the main body **10,** so as to be engaged with the fastener **50,** as shown by **Fig. 8.**

[0029] Furthermore, a position limiting portion **27** protrudes on one side of the claw **20** adjacent to the outer retaining face **231.** When the wrench **100** is not engaged with the fastener **50,** the position limiting portion **27** is applied for resisting against the first connection face **161** of the first tip **13,** so that a space surrounded by the first jaw opening **11** and the second jaw opening **21** is smaller than the outer profile of the fastener **50.**

[0030] Referring to **Fig. 5** to **Fig. 10,** the operation theory and effect of the wrench **100** of the first embodiment are illustrated. As shown by **Fig. 5** and **Fig. 6,** before the fastening operation of the fastener **50** on the oil-pipe, the combination bore **15** of the wrench **100** is combined with the hand tool **1,** and the user presses the press member **24** of the claw **20,** thereby pivoting the claw **20** to the first position. At the meantime, the positioning member **32** of the elastic positioning device **30** resists against the positioning area **33,** so that the claw **20** remains in the opening status. Therefore, when the wrench **100** approaches the peripheral space of the oil-pipe, the user only needs to grip the distal end of the hand tool **1** with one hand and move the first jaw opening **11** and the second jaw opening **21** of the wrench **100** to the peripheral space of the oil-pipe, and then axially moves the first jaw opening **11** and the second jaw opening **21** along the oil-pipe, so as to position the first jaw opening **11** and the second jaw opening **21** of the wrench **100** to the peripheral space of the fastener **50.**

[0031] Referring to **Fig. 7,** when the first jaw opening **11** and the second jaw opening **21** of the wrench **100** move to the peripheral space of the fastener **50,** the release portion **35** of the wrench **100** is applied for resisting against the fastener **50,** so that the claw **20** is able to pivot about the pivot center **C,** whereby the positioning member **32** of the elastic positioning device **30** leaves the positioning area **33** and crosses the dividing side **332** to reach the slide area **34,** and the claw **20** accordingly pivots to the second position. Alternatively, the user may achieve the identical effect by use of the inertia function, without the need of applying another hand for operating the wrench **100.** Therefore, the issue of the operation in an uneasily reached narrow space is resolved. Also, when combining the fastener **50** with the wrench **100,** the user does not need to continuously press the claw **20** for a long time

[0032] As shown by **Fig. 8** and **Fig. 9,** when the wrench **100** is completely engaged with the fastener **50,** the first forcing face **17,** second forcing face **18,** and third forcing face **19** of the main body **10** face the fourth force bearing face **54A,** third force bearing face **53A,** and second force bearing face **52A** of the fastener **50,** respectively; the inner retaining face **232** of the claw **20** faces the first force bearing face **51A;** the fourth forcing face **25** and fifth forcing face **26** of the claw **20** face the sixth force bearing face **56A** and fifth force bearing face **55A** of the fastener **50.** Therefore, the fastener **50** is engaged in the first jaw opening **11** and the second jaw opening **21.**

[0033] As shown by **Fig. 10,** the reciprocating wrench **100** for quick combining fastener **50** is in a status of screwing the fastener **50** in a clockwise direction. Currently, the wrench **100** drives the fastener **50** to rotate about the rotation center **X.** The force imposed by the user is transmitted through the block face **16** and the second tip **23** to the first force bearing face **51A** of the fastener **50.** At the same time, the force imposed by the user is also transmitted through the first forcing face **17,** second forcing face **18,** third forcing face **19,** fourth forcing face **25,** and the fifth forcing face **26** to the fourth force bearing face **54A,** third force bearing face **53A,** second force bearing face **52A,** sixth force bearing face **56A,** and fifth force bearing face **55A** of the fastener **50,** so as to screw the fastener **50.** Due to an evenly imposed force born by the fastener **50,** the wrench **100** is allowed to easily drive the fastener **50** to rotate on the thread.

[0034] When the user wishes to efficiently reciprocate the wrench **100,** the user does not have to detach the wrench **100** from the fastener **50** along the axial direction of the oil-pipe. Instead, the main body **10** rotationally reciprocates about the rotation center **X,** so that the claw **20** reciprocates due to the sliding reciprocation of the positioning member **32** of the elastic positioning device **30** on the slide area **34.** Therefore, the user is allowed to repeatedly wrench the fastener **50** until the fastener **50** is screwed to the target fastened position.

[0035] Referring to **Fig. 11,** when the fastener **50** is screwed to the target fastened position, the user may carry out the final fastening operation. The user keeps imposing the force upon the fastener **50** through the wrench **100,** so that the torque value of the wrench **100** continuously increases. The distance between the first tip **13** and the neighboring first force bearing face **51A** of the fastener **50** decreases along a direction in opposite to the expansion direction of the claw **20** with respect to the first tip **13.** The largest width of the distal end of the second tip **23** is greater than the smallest distance between the first tip **13** and the neighboring first force bearing face **51A** of the fastener **50.** Therefore, the counterforce of the first force bearing face **51A** of the fastener **50** forces the second tip **23** to resiliently expand to resist against the first tip **13;** in other words, the second tip **23** bears the counterforce to resist against the first tip **13,** such that the second tip **23** of the claw **20** is resisted and blocked by the first tip **13** and prevented from detach-

ment. As a result, at the fastened position, the second tip **23** is effectively resisted against the first tip **13,** such that the claw **20** is prevented from separation and detachment with respect to the main body **10,** facilitating the high-torque fastening operation. Even if the wrench **100** is applied in a high-torque fastening situation other than an oil-pipe worksite, the wrench **100** is still able to be stably engaged with the fastener **50** are prevented from detachment.

[0036] Referring to **Fig. 12,** a second embodiment of the present invention is illustrated. The numeric representing similar or identical components, structures, and functions of the present invention in the first embodiment are herein saved. In the second embodiment, the elastic positioning device **30** further includes a position limiting area **36,** which is disposed on the claw **20** away from the positioning area **33** and in adjacent to the slide area **34.** When the positioning member **32** of the elastic positioning device **30** resists against the position limiting area **36,** the space surrounded by the first jaw opening **11** and the second jaw opening **21** is smaller than the outer profile of the fastener **50,** and achieves an identical function with the position limiting portion **27.**

[0037] Referring to **Fig. 13,** a third embodiment of the present invention is illustrated. The difference of the third embodiment compared with the first embodiment lies in that the elastic positioning device **30** includes an elastic member **31,** a positioning member **32a,** and a positioning are **33a** which is formed on the claw **20.** The elastic member **31** is disposed on the main body **10** and provides the elastic recovering force for the claw **20** to rotate toward the closing direction. The positioning member **32a** is disposed between the main body **10** and the claw **20,** and optionally positioned on the positioning area **33a** for optionally maintaining the claw **20** in the opening status. The slide area **34** is formed on one side of the positioning area **33a** to be pushed by the elastic member **31** and generate a sliding relationship with respect to the elastic member **31.** The installation notch **122** is disposed on the pivot end **12** of the main body **10** and opens toward the claw **20.** The elastic member **31** is received in the installation notch **122** for pushing the claw **20,** such that the claw **20** normally moves toward the first tip **13.** The elastic member **31** is a compression spring disposed between the main body **10** and the claw **20.** The positioning member **32a** is a magnet disposed on the main body **10.** The positioning area **33a** is formed of a magnetic material and disposed on the claw **20** and faces one side of the main body **10.** The positioning member **32a** is able to overcome the elastic recovering force imposed by the elastic member **31** upon the claw **20** to be magnetically attached to the positioning area **33a,** such that a magnetic positioning effect is generated between the positioning member **32a** and the positioning area **33a.** The elastic member **31** includes the pushing end **311** and the inner end **312,** wherein the pushing end **311** pushes the claw **20,** and the inner end **312** resists against the installation notch **122.** The elastic member **31** and the positioning member **32a** are not disposed in a coaxial alignment and not at an identical position. In the third embodiment, the inertia of the claw **20** is applied for removing the positioning effect of the elastic positioning device **30.** Therefore, the user does not need to approach the claw **20** which is in the peripheral space of the oil-pipe by hand, assuring the safety and convenience of usage. Besides the application of the inertia technique, the opening status of the claw **20** is also allowed to be removed by use of the release portion **35.**

[0038] Referring to **Fig. 14,** a fourth embodiment of the present invention is illustrated. The operation portion **14** is a handle, allowing the user to directly grip the operation portion **14** to wrench the main body **10** without applying additional tools. Also, the wrench **100** is allowed to have a double-headed structure for enhancing the utility of usage. Further, the double-headed wrench **100** is applicable to operation sites other than an oil-pipe, achieving a widely applicable feature which is popular among customers.

[0039] Thus, the reciprocating wrench **100** for quick combining fastener **50** in accordance with the embodiments of the present invention is convenient for combining the fastener **50** without the need of continuously pressing the claw **20** for maintaining the opening status, so that the wrench **100** is easily move to the position close to the fastener **50** for combining the fastener **50.** Therefore, the inconvenience of operation in a narrow space and the difficulty of continuously pressing the claw **20** are resolved, and the safety and convenience of usage for the user in a high-temperature oil-pipe operation environment are thereby improved.

[0040] Furthermore, the present invention achieves a quick reciprocating operation. During the fastening operation, the claw **20** is prevented from separation and detachment with respect to the main body **10,** so as to assure that the main body **10** and the claw **20** are stably engaged with the fastener **50** and realize a stable high-torque fastening operation.

[0041] Although particular embodiments of the invention have been described in detail for purposes of illustration, various modifications and enhancements may be made without departing from the spirit and scope of the invention. Accordingly, the invention is not to be limited except as by the appended claims.

Claims

1. A reciprocating wrench (100) for quick combining fastener (50), comprising:

   a main body (10) comprising a concavely-shaped first jaw opening (11), the first jaw opening (11) comprising a pivot end (12) on one side thereof;
   a claw (20) comprising a concavely-shaped second jaw opening (21), the second jaw opening

(21) comprising a pivotal combination portion (22) on one side thereof, the pivotal combination portion (22) of the claw (20) being pivotally connected with the pivot end (12) of the main body (10) along a pivot center (C), such that the claw (20) pivotally moves with the pivot center (C) as a rotation center in order to optionally rotate toward a closing direction or an opening direction; and

an elastic positioning device (30) disposed between the main body (10) and the claw (20), and allowing the claw (20) to rotate toward the closing direction or optionally remain in an opening status.

2. The wrench (100) of claim 1, wherein the elastic positioning device (30) includes an elastic member (31), a positioning member (32), and a positioning area (33) which is formed on the claw (20); the elastic member (31) disposed on the main body (10) and providing an elastic recovering force for the claw (20) to rotate toward the closing direction; the positioning member (32) disposed between the main body (10) and the claw (20) and optionally being positioned on the positioning area (33) for the claw (20) to optionally remain in the opening status.

3. The wrench (100) of claim 2, wherein the claw (20) and the main body (10) pivot with respect to each other between a first position and a second position; when the claw (20) is at the first position, the claw (20) remains in the opening status with respect to the main body (10); when the claw (20) is at the second position, the claw (20) is in a closing status with respect to the main body (10).

4. The wrench (100) of claim 3, wherein at the first position, the positioning member (32) resists against the positioning area (33), so as to generate a first force (F1) and a second force (F2); a torque (M1) generated by the first force (F1) upon the pivot center (C) offsets a obverse torque (M2) generated by the second force (F2) upon the pivot center (C), such that the claw (20) remains in the opening status.

5. The wrench (100) of claim 4, wherein the elastic positioning device (30) includes a slide area (34) formed on one side of the positioning area (33) to be pushed by the elastic member (31) and generate a sliding relationship with respect to the positioning member (32); the positioning area (33) is an arc shaped groove; the positioning area (33) includes a positioning face (331) and a dividing side (332) formed on one side of the positioning face (331); a distance from the positioning face (331) to the pivot center (C) is smaller than a distance from the dividing side (332) to the pivot center (C); when the claw (20) pivots from the first position to the second position, the positioning member (32) crosses the dividing side (332) to resist against the slide area (34).

6. The wrench (100) of claim 5, wherein the main body (10) has an installation notch (122) facing the claw (20); the elastic member (31) is disposed in the installation notch (122) and pushes the positioning member (32), and the positioning member (32) is slidably disposed in the installation notch (122) and pushes the claw (20); the elastic member (31) is a compression spring, and the positioning member (32) is a hollow pin formed of a metal material; the positioning member (32) has a body portion (321) on one end thereof; the body portion (321) is slidably disposed in the installation notch (122) and comprises an inner bore (322) whose sectional face is formed in a circular shape; the positioning member (32) has a hemisphere shaped resisting end (323) formed on one end thereof in opposite to the inner bore (322) and connected with the body portion (321); the elastic member (31) comprises a pushing end (311) and an inner end (312); the pushing end (311) pushes the inner bore (322) of the positioning member (32), and the inner end (312) contacts the installation notch (122).

7. The wrench (100) of claim 3, wherein a slide area (34) is formed on one side of the positioning area (33a) to be pushed by the elastic member (31) and generate a sliding relationship with respect to the elastic member (31); the elastic member (31) is a compression spring disposed between the main body (10) and the claw (20); the positioning member (32a) is a magnet disposed on the main body (10); the positioning area (33a) is formed of a magnetic material and disposed on the claw (20) and faces one side of the main body (10); the positioning member (32a) is able to overcome the elastic recovering force imposed by the elastic member (31) upon the claw (20) to be magnetically attached to the positioning area (33a), such that a magnetic positioning effect is generated between the positioning member (32a) and the positioning area (33a).

8. The wrench (100) of anyone of claim 1 to claim 7, wherein when the claw (20) remains in the opening status, an inertia of the claw (20) is applied for removing a positioning effect of the elastic positioning device (30), such that the claw (20) changes to a closing status.

9. The wrench (100) of anyone of claim 1 to claim 7, wherein the elastic positioning device (30) comprises a release portion (35) disposed on the claw (20); when the claw (20) is in the opening status, the release portion (35) protrudes from an inner side of the first jaw opening (11) with respect to the main body (10).

10. The wrench (100) of claim 5, wherein the elastic positioning device (30) further comprises a position limiting area (36) disposed on the claw (20) away from the position limiting area (33) and in adjacent to the slide area (34); when the positioning member (32) resists against the position limiting area (36), a space surrounded by the first jaw opening (11) and the second jaw opening (21) is smaller than an outer profile of the fastener (50).

11. The wrench (100) of claim 3, wherein the first jaw opening (11) has a first tip (13) on one side thereof in opposite to the pivot end (12); the second jaw opening (21) has a second tip (23) on one side thereof in opposite to the pivotal combination portion (22); when the claw (20) is at the second position and the wrench (100) is engaged with the fastener (50) in a fastening operation, the fastener (50) is positioned in the first jaw opening (11) and the second jaw opening (21); a distance between the first tip (13) and a neighboring first force bearing face (51A) of the fastener (50) decreases in a direction in opposite to an expansion direction of the claw (20) with respect to the first tip (13); a largest width of a distal end of the second tip (23) is greater than a smallest distance between the first tip (13) and the neighboring first force bearing face (51A) of the fastener (50); a counterforce of the first force bearing face (51A) of the fastener (50) forces the second tip (23) to expand to resist against the first tip (13).

12. The wrench (100) of claim 11, wherein the second tip (23) comprises an outer retaining face (231) and an opposite inner retaining face (232); a longest distance between the outer retaining face (231) and the pivot center (C) is defined as a first radius (RI), and a shortest distance between the inner retaining face (232) and the pivot center (C) is defined as a second radius (R2), wherein the first radius (RI) is larger than the second radius (R2); when the wrench (100) is not engaged with the fastener (50), the first radius (R1) is smaller than a shortest distance between the first tip (13) and the pivot center (C); when the wrench (100) is engaged with the fastener (50) during the fastening operation, the second tip (23) resiliently expands, such that the longest distance between the outer retaining face (231) and the pivot center (C) is greater than the shortest distance between the first tip (13) and the pivot center (C).

13. The wrench (100) of claim 12, wherein the pivotal combination portion (22) of the claw (20) is pivotally connected with the pivot end (12) of the main body (10) through a single trunnion (28); the first tip (13) has a block face (16); the first jaw opening (11) of the main body (10) has a first forcing face (17), a second forcing face (18), and a third forcing face (19) sequentially disposed in a clockwise direction from one side of the block face (16); when the wrench (100) is engaged with the fastener (50), the block face (16) faces the outer retaining face (231) of the claw (20); the first forcing face (17), the second forcing face (18), and the third forcing face (19) face a fourth force bearing face (54A), a third force bearing face (53A), and a second force bearing face (52A) of the fastener (50), respectively; a press member (24) extends to be formed on the pivotal combination portion (22) of the claw (20); the inner retaining face (232) faces the first force bearing face (51A) of the fastener (50); the claw (20) comprises a fourth forcing face (25) and a fifth forcing face (26) which face a sixth force bearing face (56A) and a fifth force bearing face (55A) of the fastener (50), respectively; a first inclination angle (θ1) is included by the block face (16) and the first force bearing face (51A), and a second inclination angle (θ2) is included by the outer retaining face (231) and the first force bearing face (51A), and the second inclination angle (θ2) is smaller than the first inclination angle (θ1); the block face (16) and the first force bearing face (51A) form a block effect with the second tip (23), so as to prevent the second tip (23) from detaching with respect to the block portion (13).

14. The wrench (100) of claim 13, wherein a position limiting portion (27) protrudes on one side of the claw (20) adjacent to the outer retaining face (231); when the wrench (100) is not engaged with the fastener (50), the position limiting portion (27) resists against the block portion (13).

15. The wrench (100) of claim 13, further comprising a first imaginary line (LI) and a second imaginary line (L2); the first imaginary line (LI) passes through the pivot center (C), a rotation center (X) of the fastener (50), the second tip (23), and the first tip (13); the second imaginary line (L2) passes through the first imaginary line (LI) and the rotation center (X) of the fastener (50); the main body (10) comprises an operation portion (14) formed on a position away from the first jaw opening (11); the operation portion (14) comprises a combination bore (15); the combination bore (15) passes through the main body (10) and is arranged in parallel to the rotation center (X) of the fastener (50); a plurality of concaves (60) are disposed on an inner edge of the first jaw opening (11) and an inner edge of the second jaw opening (21) for facing a second obverse force bearing face (52B), a third obverse force bearing face (53B), a fourth obverse force bearing face (54B), the fifth obverse force bearing face (55B), and a sixth obverse force bearing face (56B) of the fastener (50), respectively; each of the fourth forcing face (25), the fifth forcing face (26), and the inner retaining face (232) comprises a plurality of skid proof grooves (61), respectively; each of the first forcing face (17), the second forcing

face (18), and the third forcing face (19) has a plurality of skid proof grooves (61), respectively; the pivot end (12) includes two pivot ears spaced with each other, and each pivot ear comprises a first pivot hole (121), respectively; the claw (20) comprises a second pivot hole (221), such that the trunnion (28) passes through the two first pivot holes (121) and the second pivot hole (221) along the pivot center (C).

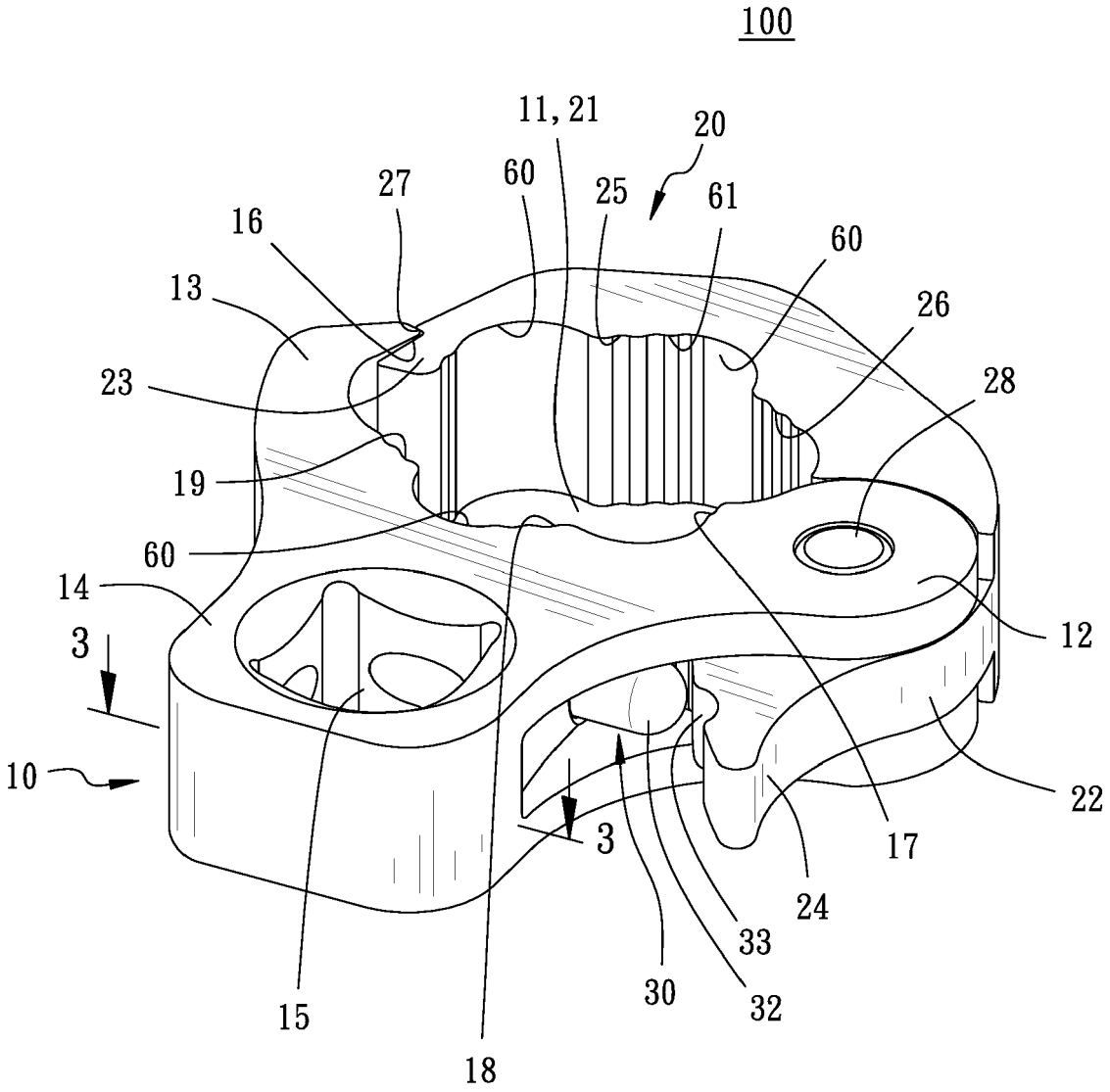
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FIG. 1

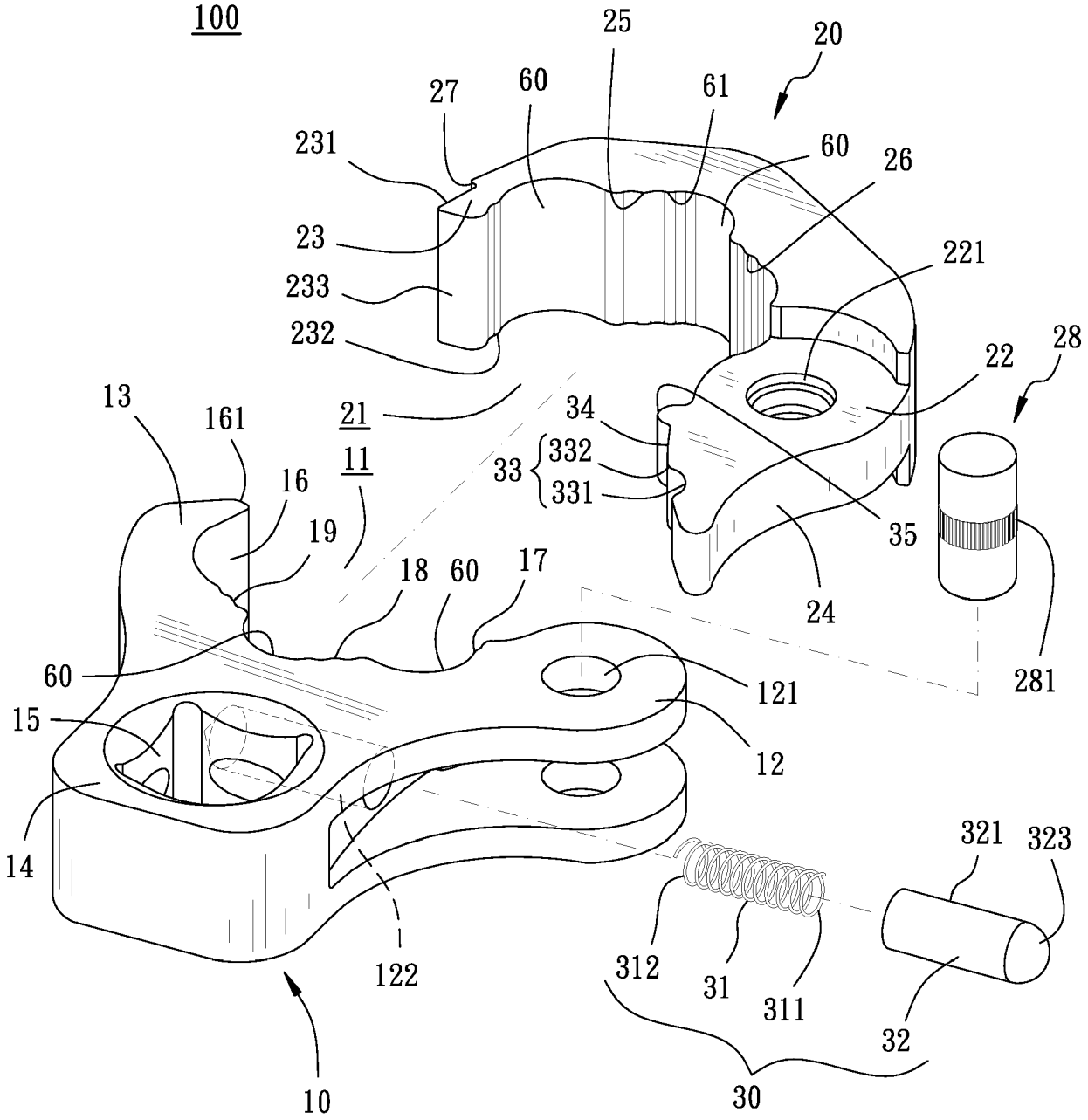
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FIG. 2

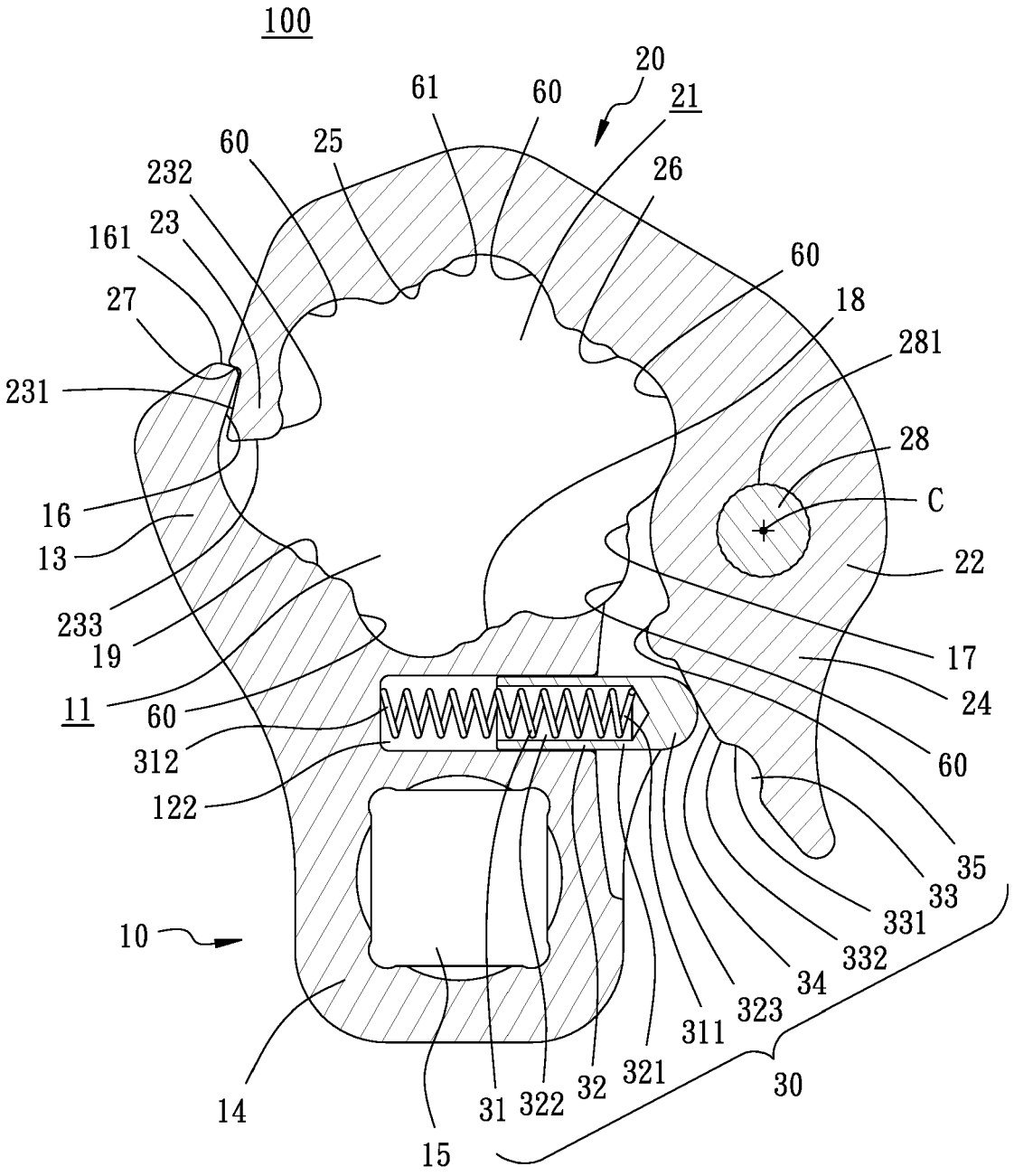
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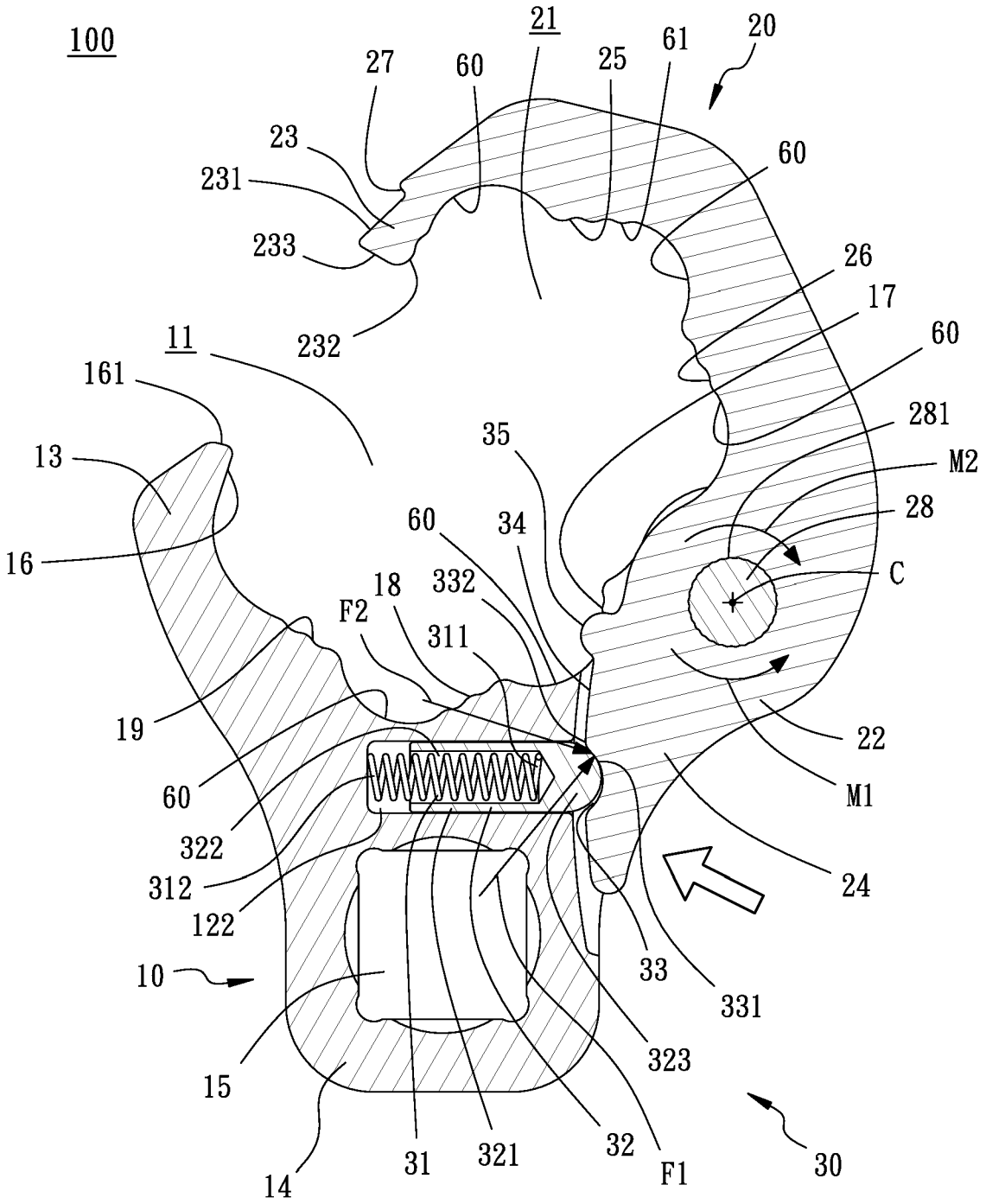
FIG. 3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34
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C
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311
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FIG. 4

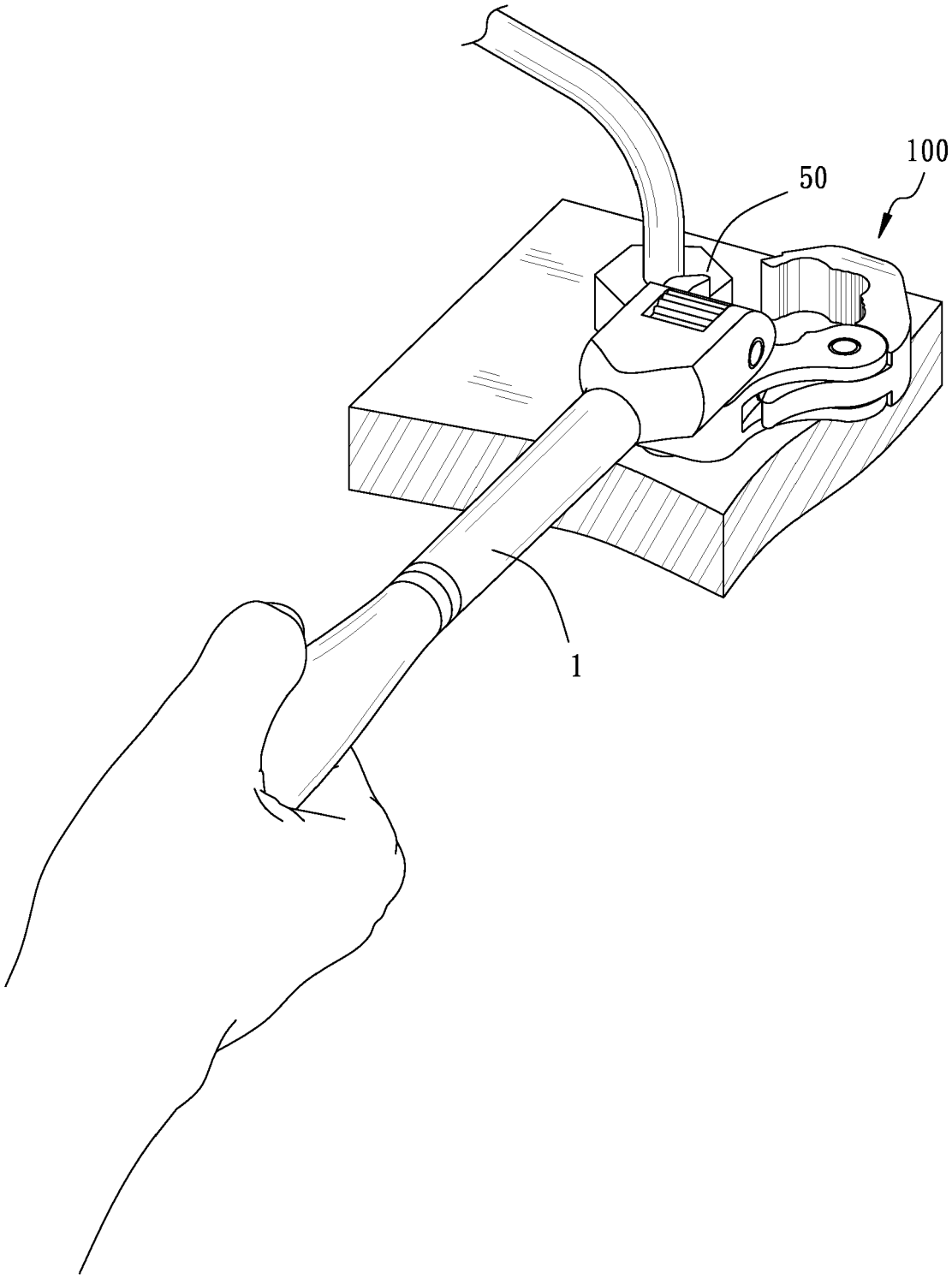

FIG. 5

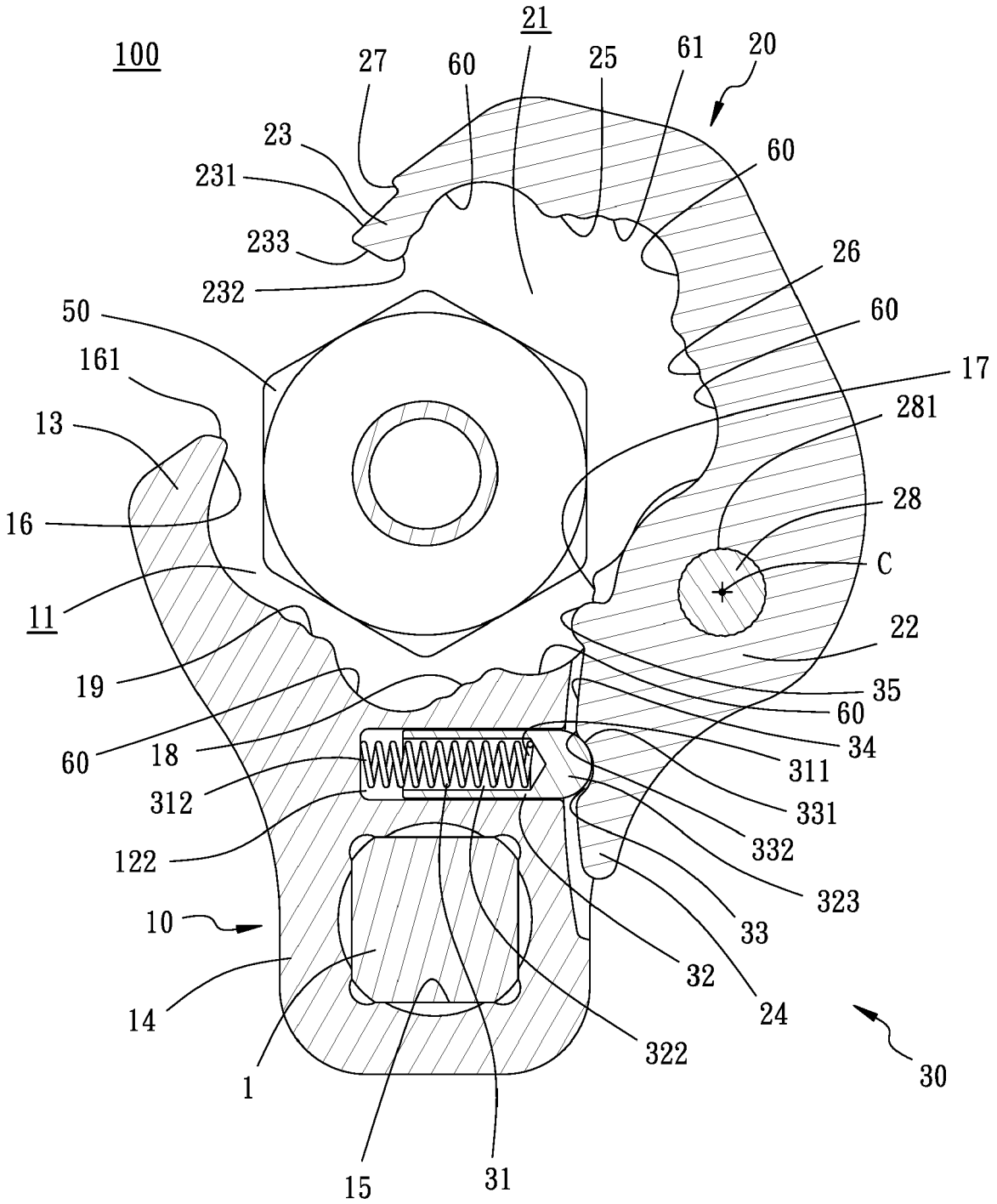
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FIG. 6

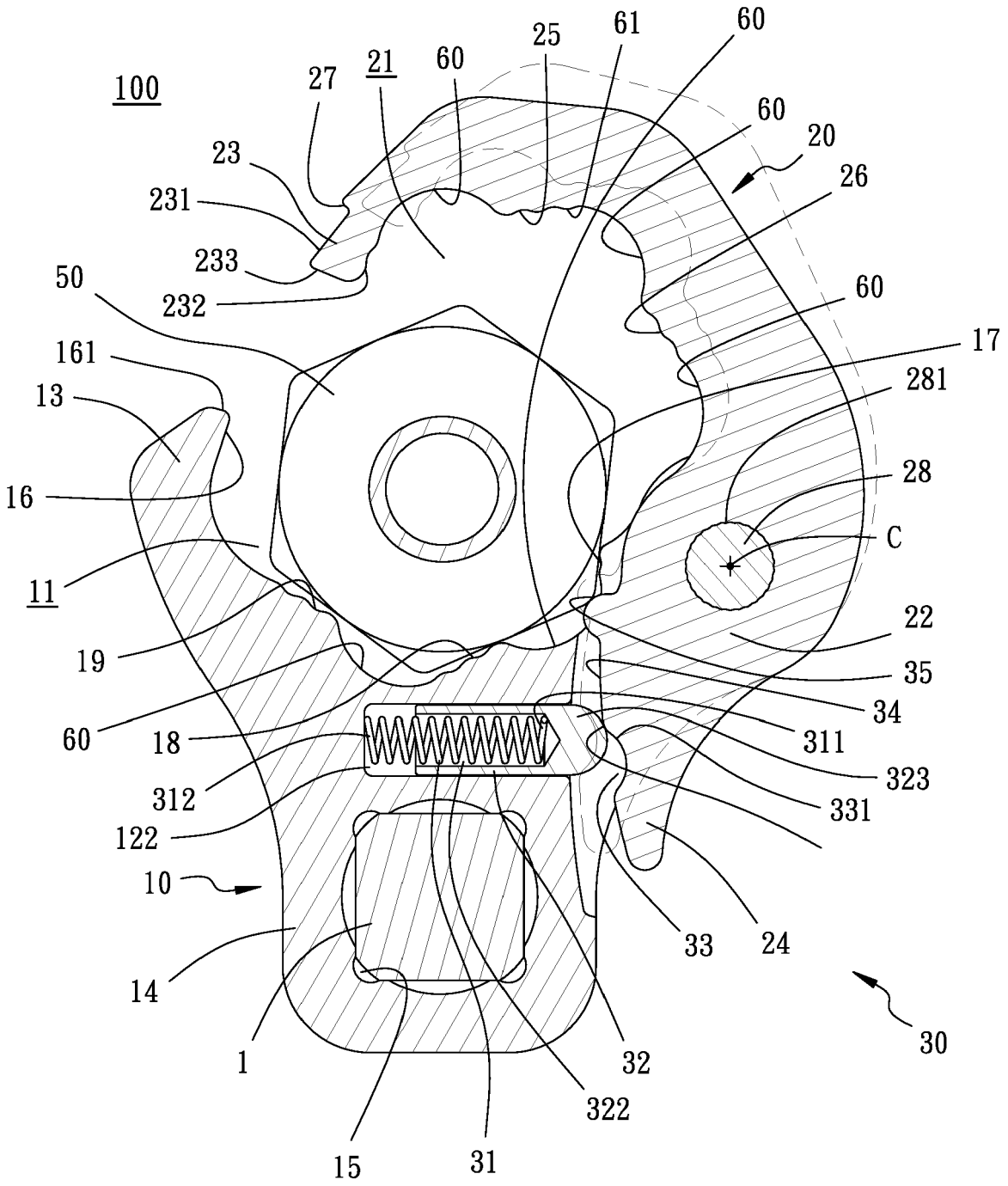
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FIG. 7

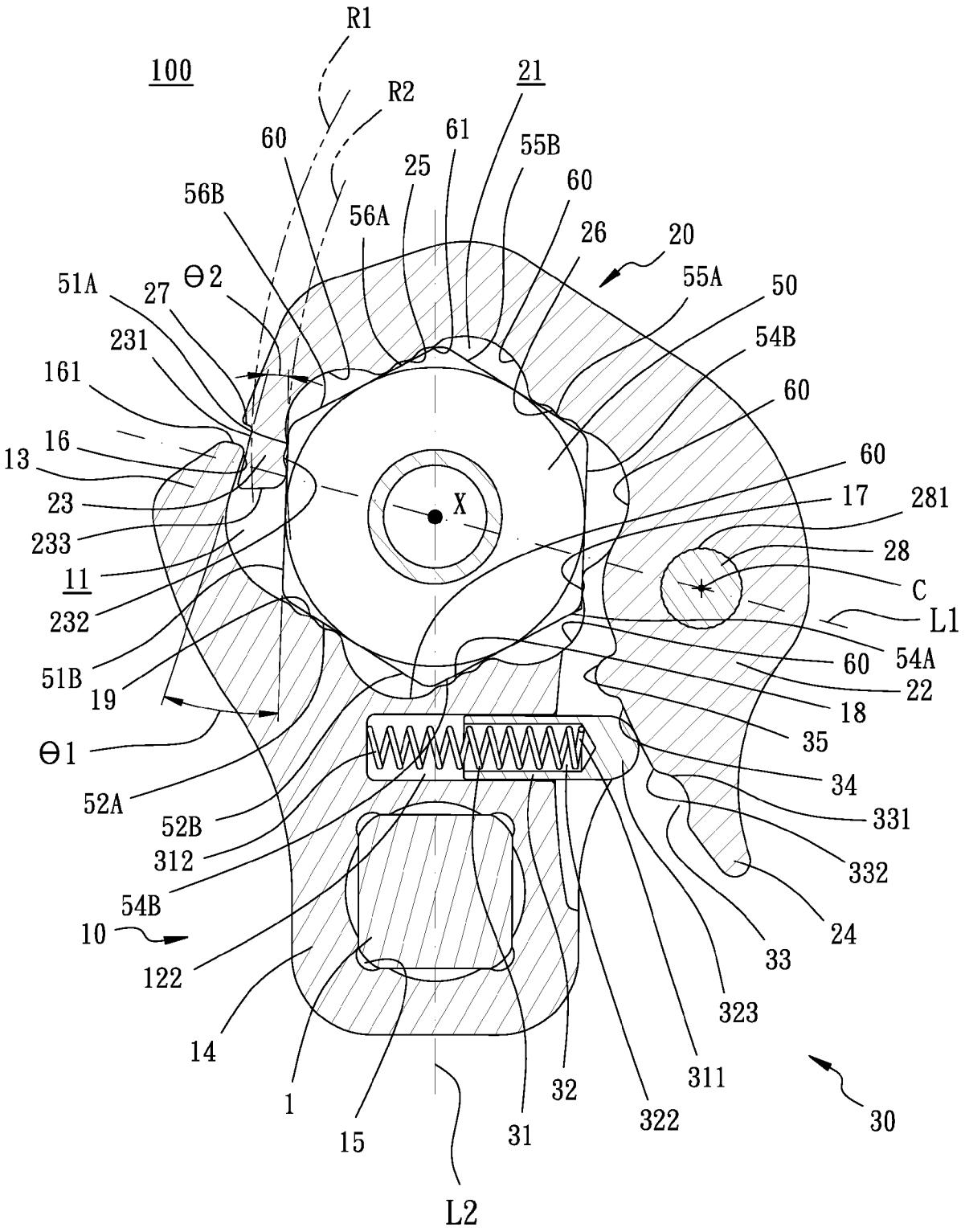
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FIG. 8

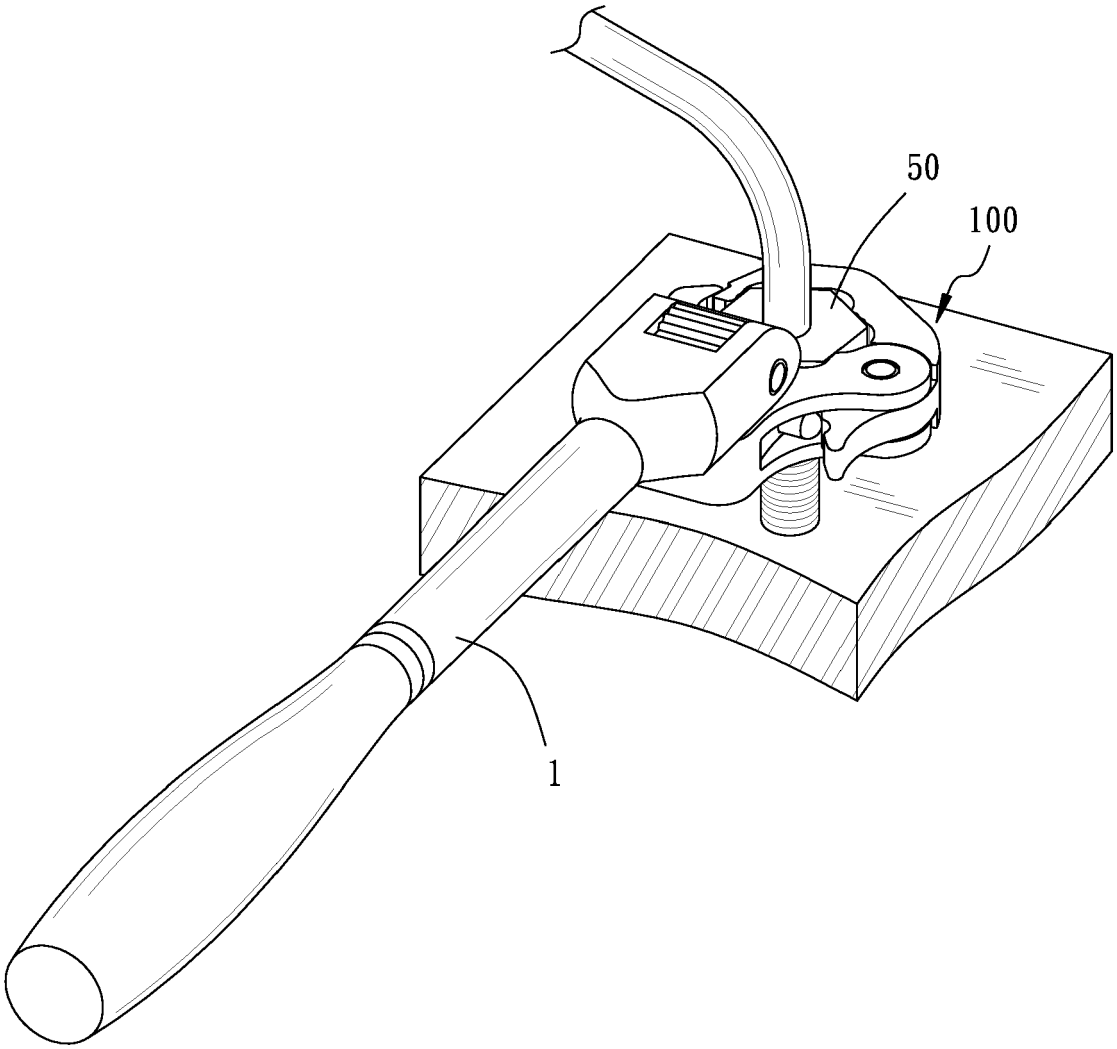

FIG. 9

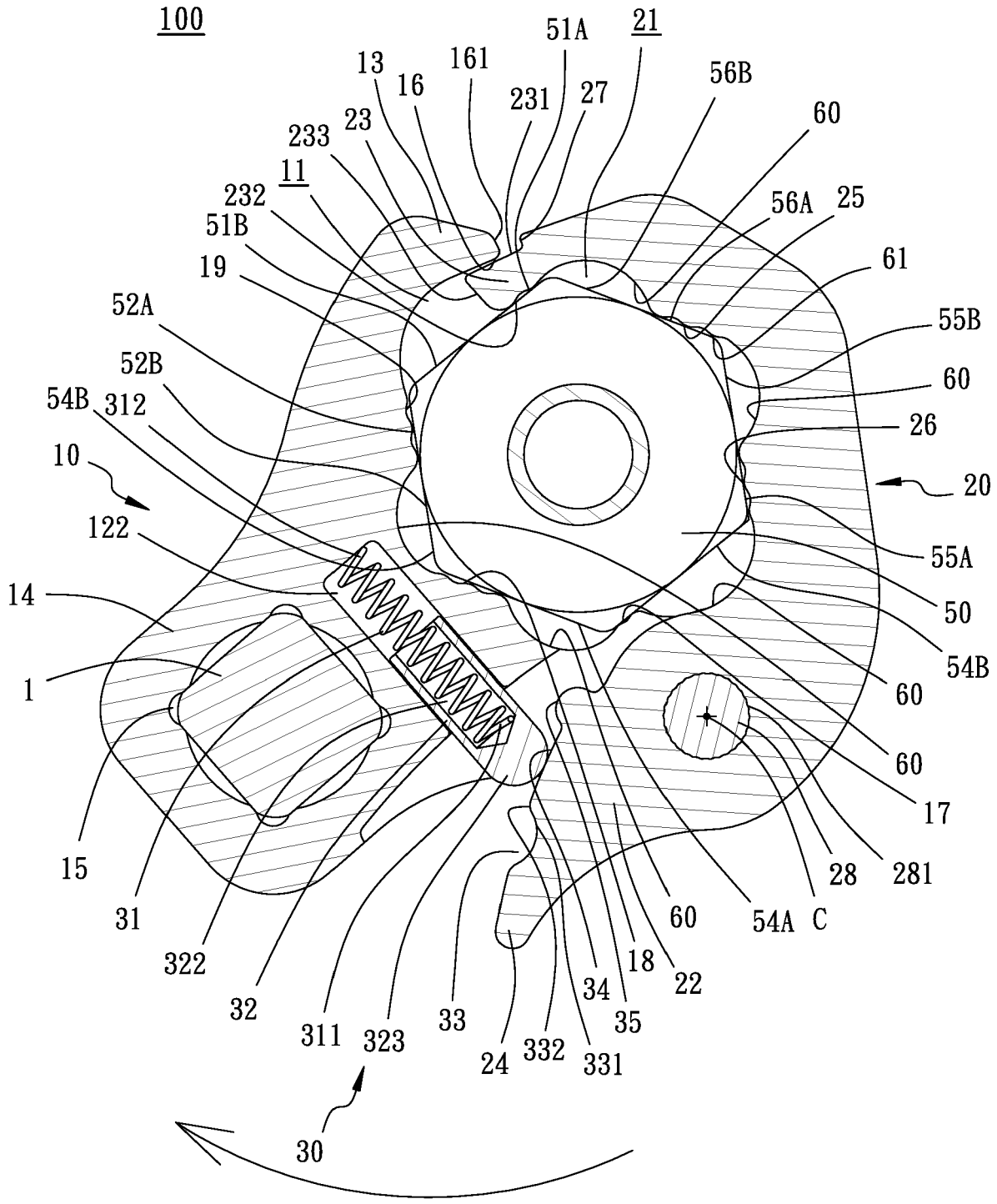
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FIG. 10

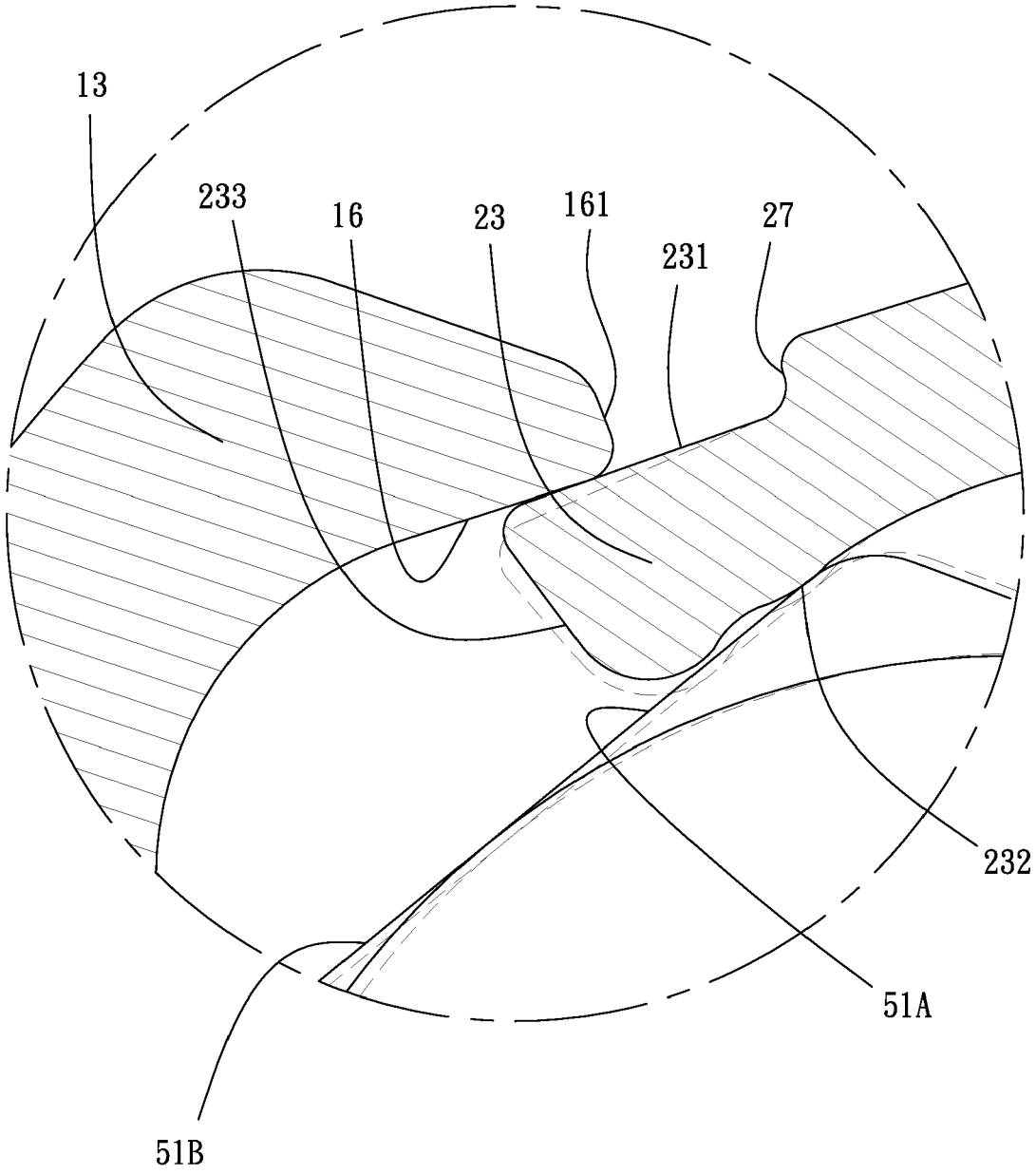

FIG. 11

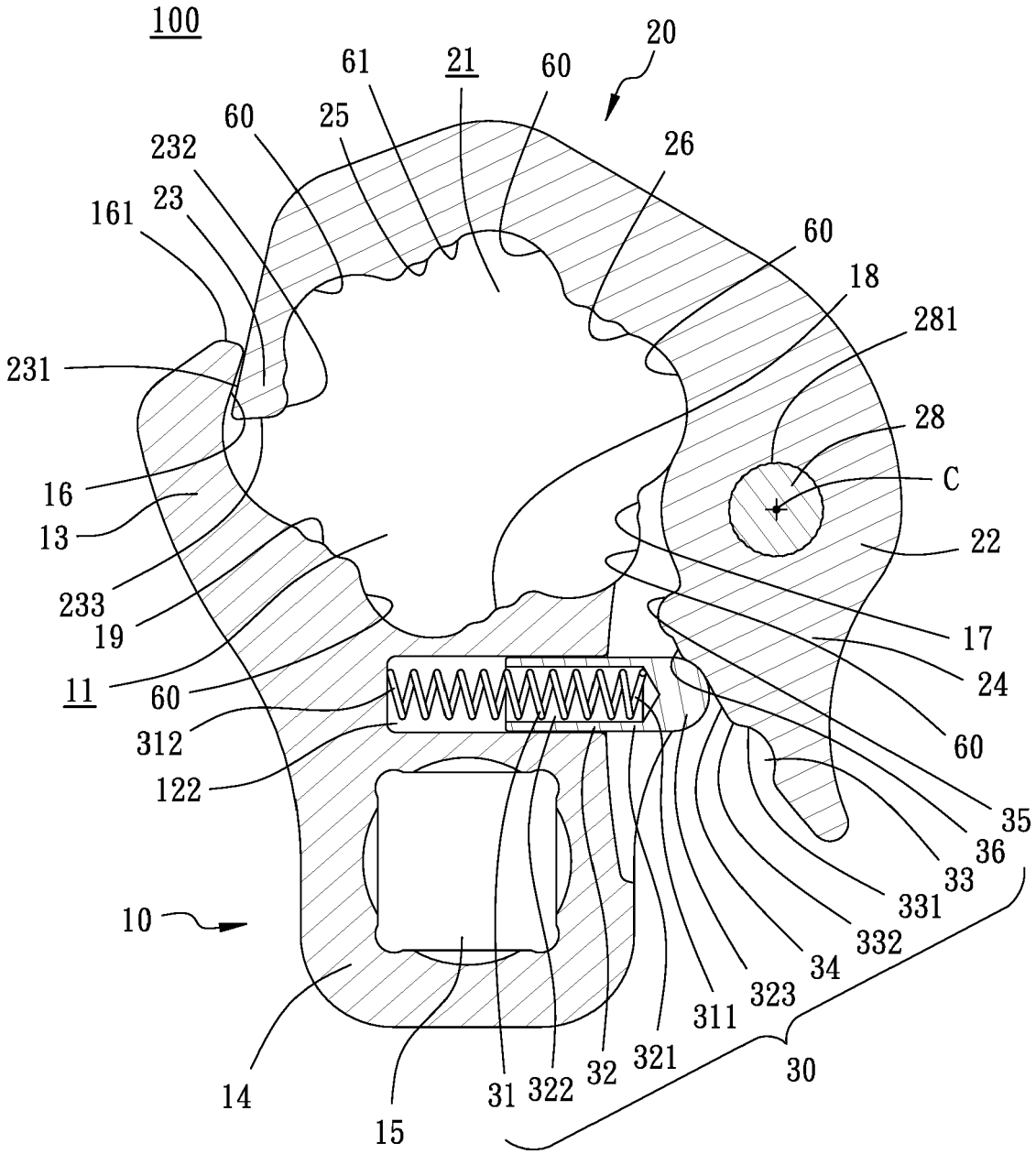
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FIG. 12

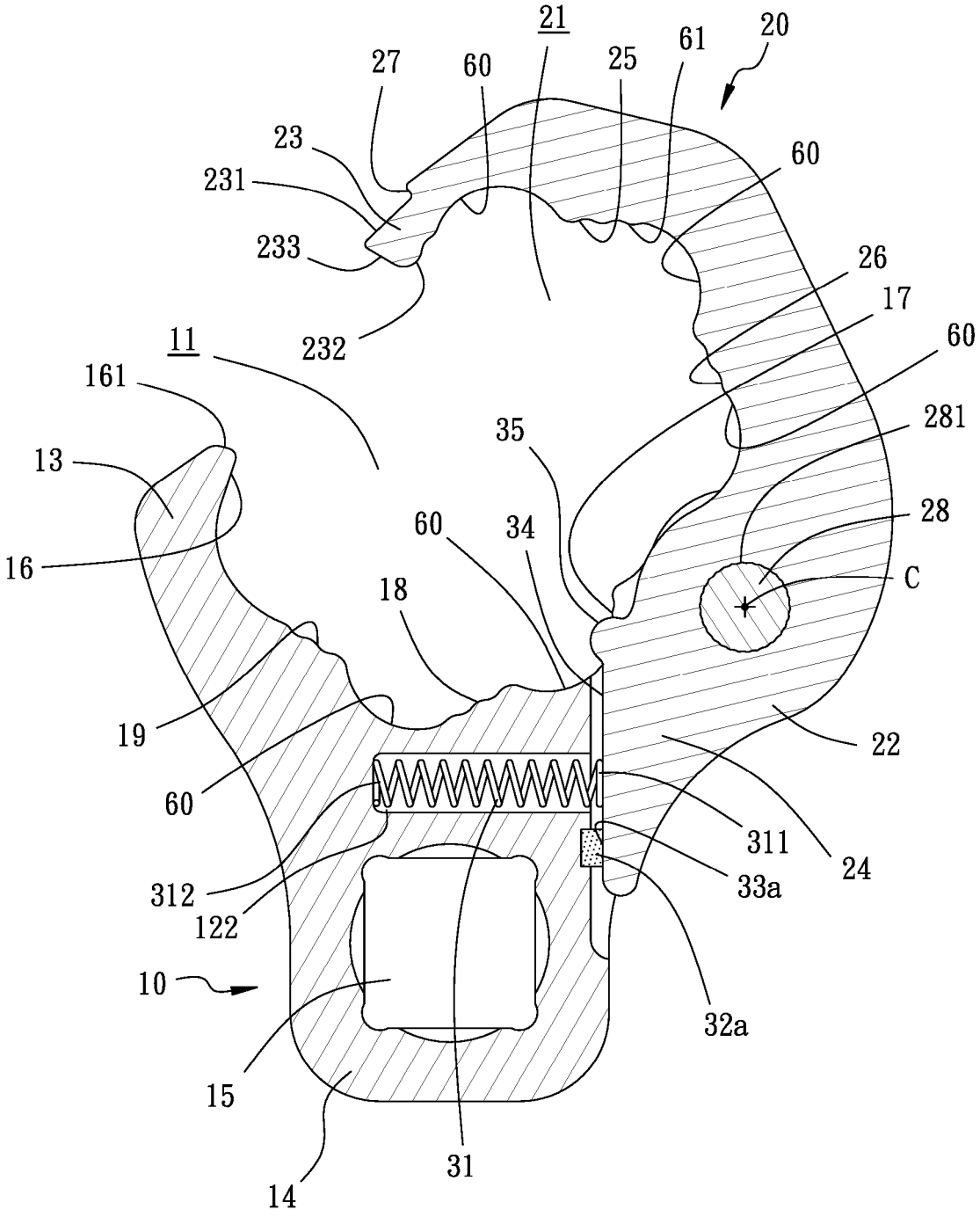
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FIG. 13

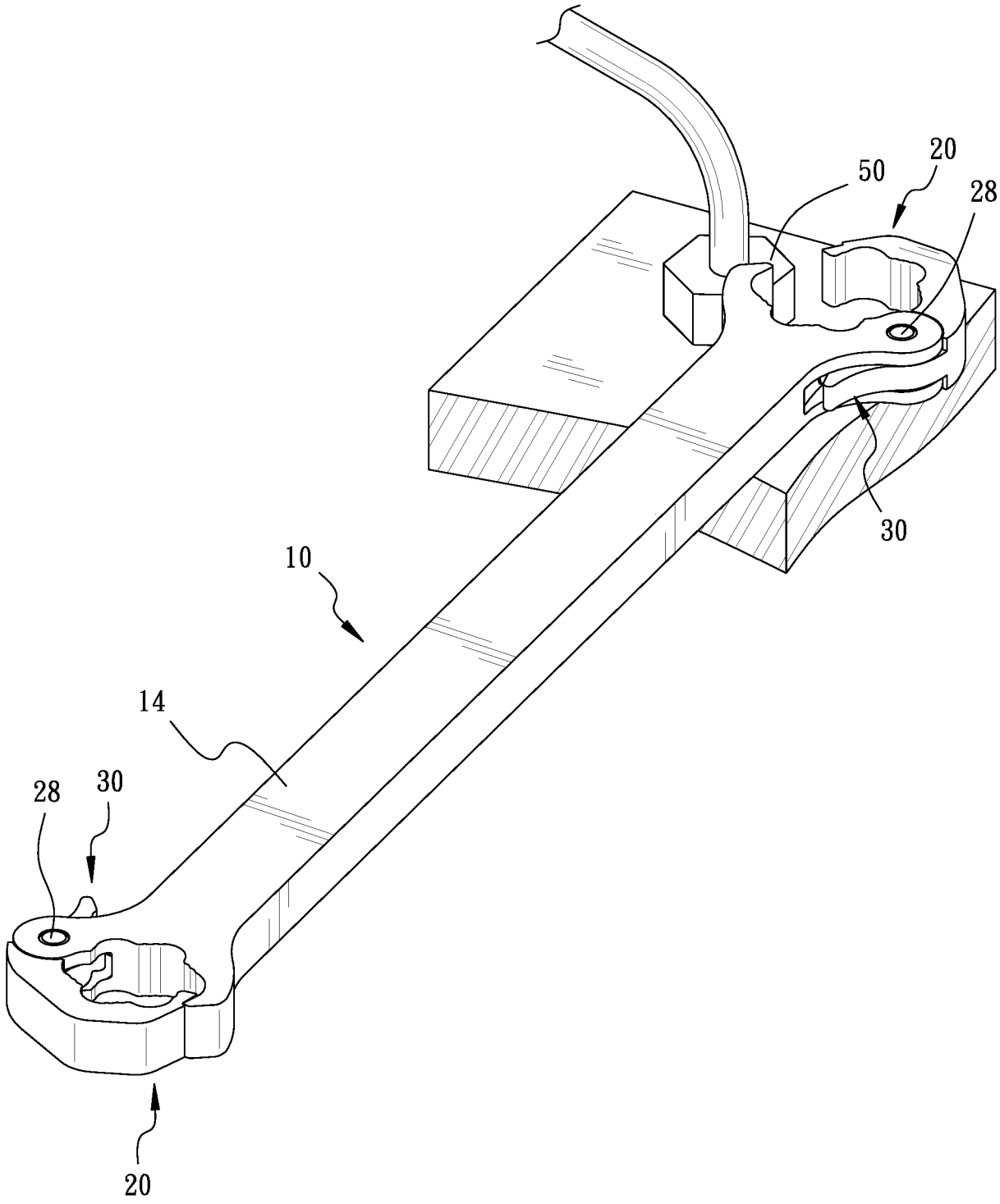

FIG. 14

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 19 20 7641

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2 814 225 A (MORLEY MANN) 26 November 1957 (1957-11-26) * figures 1-6 * -----	1,8,9	INV. B25B13/04 B25B13/46 B25B13/28
X	US 2 446 776 A (OLOF MATSON) 10 August 1948 (1948-08-10) * figures 1,2 * -----	1,8,9	B25B13/48 B25B13/34
A	DE 20 2006 001836 U1 (HUANG CHIU TA [TW]) 30 March 2006 (2006-03-30) * figures 1-6 * -----	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

B25B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 May 2020	Hartnack, Kai

CATEGORY OF CITED DOCUMENTS

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